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DISTRIBUTION, NATURAL ENEMIES AND BREEDING HABITS OF THE KANSAS POCKET GOPHER.

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THE following notes embody some of the results of investigations of the pocket gopher, conducted principally at Manhattan. Data were also collected in a number of trips made to various parts of the state, including the banner alfalfa counties, the irrigated lands of the Southwest, the potato-growing districts of the Kansas valley, and nurseries and orchards in several quarters.

DISTRIBUTION.

The prairie pocket gopher, *Geomys bursarius*, is distributed over that part of the upper Mississippi valley which includes the central and eastern parts of the Dakotas, Nebraska, and Kansas, the whole of Iowa, and portions of Missouri, Illinois, Wisconsin, and Minnesota. On the west, excepting in the Dakotas, its range meets and partly overlaps that of the plains pocket gopher, *G. lutescens*, and on the south that of the Louisiana gopher, *G. breviceps*. In the western part of the Dakotas *Geomys* is replaced by a distinct genus, *Thomomys*, inhabiting nearly the whole of the Rocky Mountains and Pacific regions.

KANSAS SPECIES.

In Kansas the dominant species of gopher is *G. bursarius*. It is most abundant in the central and northeastern parts of the state, and ranges at least as far west as the ninety-ninth meridian. Here it is partly, and a little further west fully, replaced by the paler, sand-colored species, *G. lutescens*. Whether the two species intergrade on the common border of their respective ranges I have not been able to determine. In no part of western Kansas have I found the plains pocket gopher very plentiful. It is more scattering in its distribution than *G. bursarius*, being locally abundant only in the gravel flats along the streams or among the sand hills. The harder soil of the buffalo-grass tracts has little attraction for this burrowing animal. In the lower Arkansas valley of south-central Kansas the species becomes as abundant, however, as does *G. bursarius* in any quarter of the state.

If reports of depredations by pocket gophers and demand for measures of repression and extermination can be taken as an index to distribution, it may be seen from the accompanying map that

Geomys bursarius is most abundant in the region drained by the Kansas river and the lower courses of its main tributaries. The area of greatest infestation is also shown to include that portion of the Arkansas Valley east of Great Bend, but here the plains species is the more abundant. A personal survey of the valleys of the Kansas, the Blue, the Republican, the Solomon, the Smoky Hill and the lower Arkansas confirms the evidence of the map to which I have referred. Southeastern Kansas seems to be comparatively free from the pest, at least in numbers sufficient to make it troublesome. In this region and along the south-central border of the state the range of *G. bursarius* probably meets that of the Louisiana pocket gopher, *Geomys breviceps*. The evidence of this is shown by specimens from the valley of the Ninnescah—now in the zoölogical collection at Washington—having some characteristics of both species.

NATURAL ENEMIES.

Since the pocket gopher so seldom shows itself outside of its subterranean galleries, it has little to fear from the natural enemies of the rodent race. It is not entirely safe from attack, however, for a few sharp-eyed and vigilant foes habitually capture numbers of gophers when they come to the mouths of their burrows to push out a load of earth. Hawks and owls take toll at these favorable moments, and many a house cat has learned the trick of capturing a meal then with little difficulty.

The gopher's habit of confining active operations in mining mainly to the hours of twilight particularly favors the owl and the cat. The Great Horned owl, the Long-eared owl, and the Barn owl, particularly the last named, render valuable service in keeping down the numbers of these destructive rodents. A single pair of owls, nesting on the farm, have been known to destroy scores of gophers in a brief season. Sometimes they live on nothing else for a time, as evidenced by the pellets of bones and fur which they, like most birds of prey, invariably disgorge after a meal.

Instances of a house cat becoming addicted to the gopher habit are not uncommon. In a number of cases that were reported directly to me, mother cats brought in several gophers a day, regularly as clockwork, to their families of kittens. In many instances of reported gopher-catching, however, the informant has had in mind the little striped "gopher," or ground squirrel.

Two enemies that in some localities are said to hold the pocket gopher in check more than all others are the weasel and the bull snake. The former is too scarce in most parts of Kansas to be

worth considering in this relation; but the bull snake is common enough on farms whose owners or tenants have had the wisdom and forethought to protect the natural enemies of the destructive rodent tribe. The snake is able to gain entrance to the gopher's runway not only when the latter is temporarily left open, but also by vigorously burrowing into the loose earth about a fresh mound. In a case that came to my notice a large bull snake was surprised in the act of trying to force his way into a burrow. The observer quietly approached and for some minutes watched the reptile at work. The *modus operandi* was to force the snout into the soil by moving the head and neck from side to side, accompanied by a slight rotary motion as the strong, rigid muscles of the body folds came into play. At intervals, as the folds were crowded back upon one another by this exertion, the front part of the body would come out of the deepening excavation, scooping along a quantity of earth in the curve between the head and neck. Only a short distance from this snake another was crawling about over a gopher hill, evidently seeking for an entrance or a favorable spot for forcing one. Catching sight of the intruder, he became alarmed and made off in some haste. When the observer quit the field the first snake had burrowed to a depth of five or six inches and was still at work. Once inside, the snake probably remains there for some time and makes things interesting for the occupants. When one is trapping gophers he will occasionally surprise a bull snake in the act of trying to swallow the captured animal, trap and all. I have also found this snake in the burrow of the striped spermophile, helping himself to a nestful of the young of the latter, and have seen him capture and kill the adult spermophile at the mouth of its burrow.

The little striped skunk (*Spilogale interrupta*) should not be left out of account in discussing the natural enemies of the pocket gopher. I had not supposed that these animals could make their way through the burrows of the gopher, and had laid to the charge of weasels a number of cases of killing and feeding on gophers imprisoned in steel traps. Finally I resorted to setting traps a second time in the mouths of the burrows where a gopher had been partly eaten, and in two instances succeeded in capturing a little striped skunk. There was no question in either case but that the skunk had entered the burrow at some point remote from the location of the trap, for the opening through which the trap had been introduced had been carefully covered with a board and loose earth; this covering was undisturbed. In comparing this slender little

skunk's body with the diameter of many of the gopher burrows in alfalfa fields, it will be seen at once that it is not a difficult matter for the skunk to make his way through the underground passages. The additional fact that by digging he can enter the burrow at any point and corner the occupant in some lateral or pocket tunnel renders the little striped skunk especially valuable as a gopher-catcher.

In summary, it may be said that we cannot, except in a few favored localities, depend upon natural forces to keep in check the increase of the pocket gopher. On one hand, by increasing the acreage of alfalfa we are producing the very conditions that are favorable to the most rapid multiplication of the species; and, on the other hand, by thoughtlessly or wantonly destroying harmless owls, hawks, bull snakes, and certain mammals, we still further interfere with nature's efforts to preserve the balance of power in the animal world. The worst that can be said of the enemies of the pocket gopher is that the Great Horned owl, the weasel and the skunk sometimes destroy domestic fowls. But a little wise precaution in shutting up coops at night would prevent these inroads on the poultry industry.

BREEDING HABITS.

But little information along this line was obtainable in the literature accessible to the writer, and some of the statements therein made are, in the light of our own investigations, found to be more or less erroneous. The pocket gopher lives such a secluded life in its underground burrows that direct observations of its breeding habits require considerable painstaking effort. I have never been able to find a litter of the young myself, although I have explored a great many burrows in studying the animal. Occasionally, though, I have run across a nest of soft, dry grass that had probably been constructed for the purpose of rearing the young.

As might be expected of animals living in such comparative security, the pocket gopher is not a very prolific breeder. It certainly rears but one litter a year in this locality, for I have examined scores of specimens in all months of the year and have found the embryos only in late winter and early spring. The number of young in a litter varies from three to six, and averages a little more than four. Very rarely only two embryos are found in the uteri.

Quite early in the spring, before the snows are fairly gone, the male gophers are said to roam about in search of mates. As I have never encountered one on such amorous errands intent, I have not been able to verify the statement. It is entirely probable, however,

that for reasons of personal safety such excursions are undertaken mainly after nightfall. If the statements concerning the wanderings of the males are correct, the period of gestation is short, for the young are nearly all born, in this locality, in March and April. It seems more probable, however, that mating takes place in late fall as well as in early spring; perhaps also during milder periods of the winter, as fairly well-developed embryos are found in the uteri from January to May. The following table gives the results of some investigations conducted in the spring of 1907 and spring of 1908:

Number of females examined, and date.	Number of embryos.	Stage of development of embryos, etc.
<i>1907.</i>		
4..... Feb. 27	0	No signs of pregnancy.
2..... Mar. 15	4, 5	1 lot nearly fully developed, the other a little less so.
4..... Mar. 18	5, 5, 0, 0	1 lot only slightly developed; 1 lot about an inch long, thick as one's finger; 1 female evidently pregnant, but foeti not distinguishable; 1 female, no signs of pregnancy.
1..... Mar. 19	0	Uteri congested, but foeti not distinguishable.
2..... Mar. 25	3, 4	1 lot size of thumb; 1 lot size of peanut kernel.
2..... Mar. 26	1, 0	1 lot size of peanut kernel; 1 female gave evidence of having been suckled.
2..... Apr. 1	3, 4	1 lot size of pea; 1 lot size of peanut kernel.
3..... Apr. 4	4, 4, 5	2 lots size of end of thumb; 1 lot size of peanut kernel.
3..... Apr. 5	4, 4, 5	2 lots size of end of one's finger; 1 lot size of peanut kernel.
1..... Apr. 8	0	Evidence that young had been born.
3..... Apr. 9	4, 4, 4	2 lots foeti in early stages of development; 1 lot size of end of thumb.
3..... Apr. 15	5, 5, 0	2 lots foeti size of hulled peanut; no foeti distinguishable in other female.
2..... Apr. 22	4, 4	1 lot size of pea; 1 lot size of hulled peanut.
2..... Apr. 24	4, 3	1 lot in early stage of development; 1 lot size of end of little finger.
2..... May 3	0, 0	Young evidently born; milk in glands of females.
5..... May 7	3, 0, 0, 0, 0	1 lot of foeti size of pea; 2 females showed no signs of pregnancy nor of having had young; 2 females had milk in glands.
10..... May 13	2, 4, 0, 0, 0, 0, 0, 0, 0, 0	7 females contained no foeti and gave no evidence of suckling young; 1 female had milk in glands; 1 lot of foeti size of pea; 1 lot size of lima bean.
7..... May 14	0, 0, 0, 0, 0, 0, 0	No trace of foeti or evidence of suckling young.
10..... May 20	0, 0, 0, 0, 0, 0, 0, 0, 0, 0	Of the 10 females none carried foeti and only 3 gave evidence of being suckled.
<i>1908.</i>		
2..... Jan. 31	0, 4	1 female showed no signs of pregnancy; 1 lot of foeti size of peanut kernel.
4..... Feb. 5	5, 0, 0, 0	1 lot of foeti size of pea; 1 female no traces; 2 females had congested uteri.
5..... Feb. 7	5, 0, 0, 0, 0	1 lot foeti size of peanut kernel; 2 females no traces; 2 females with congested uteri.
3..... Feb. 8	0, 0, 0	2 females no traces; 1 female with congested uteri.
9..... Feb. 10	6, 6, 5, 0, 0, 0, 0, 0, 0	1 lot size of pea; 1 lot size of peanut kernel; 1 lot size of end of little finger; 2 females no traces; 4 females with congested uteri.
4..... Feb. 12	4, 0, 0, 0	1 lot size of pea; 1 female no traces; 2 females with congested uteri.

It will be seen that of the ninety-five females examined, some showed signs of pregnancy in the latter part of January, and all but two or three had given birth to their young before the first week in May. The record for some parts of the season is not so complete, however, as it should be. It should include data for the remainder of January and for the first half of March.

The young are described as being entirely hairless, with transparent skin of a delicate pinky-white. They are blind, their ears are sealed, and in most respects, therefore, they are perfectly helpless. In the fall one may still distinguish the younger specimens by their smaller size, but most of them seem to be fully grown by the advent of cold weather. Long before this time they have excavated burrows of their own and laid up some stores for the winter.